



FAA-E-2357
July 11, 1968

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

RECEIVER, ILS REMOTE MONITOR

1. SCOPE AND CLASSIFICATION.

1.1 Scope.- The equipment defined herein consists of two solid-state receivers and associated antennas designed to provide remote monitoring of the ILS localizer and glide slope facilities at installations where landlines between these facilities and the remote monitoring location are not provided. Each receiver, upon reduction or loss of input signal provides an aural and visual alarm. Also covered in an ILS remote status unit which duplicates the alarm output indications of the two receivers.

1.2 Classification.- Two types of receivers, two types of antennas, and a remote status unit are covered herein. The receivers and antennas differ with respect to the RF frequency of operation as follows:

Type I	108.1 to 111.9 MHz
Type II	329.3 to 335.0 MHz

2. APPLICABLE DOCUMENTS.

2.1 FAA specifications.- The following FAA specifications of the issues specified in the invitation for bids or request for proposals, form a part of this specification:

FAA-D-638	Instruction Books, Electronic Equipment
FAA-G-2100/1	Electronic Equipment, General Requirements Part I, General Requirements for all Equipments
FAA-G-2100/3	Part 3, Requirements for Equipments Employing Semiconductor Devices
FAA-G-2100/4	Part 4, Requirements for Equipments Employing Printed Wiring Techniques
FAA-G-2300	Panel and Vertical Chassis, Rack

(Copies of this specification, and of the applicable FAA specifications and drawings, may be obtained from Federal Aviation Administration, Washington, D. C. 20590, Attn: Contracting Officer. Request should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also request should state the contract involved or other use to be made of the requested material.)

2.2 Military publications.- The following Military publications of the issues in effect on date of the invitation for bids or requests for proposals, form a part of this specification.

MIL-C-3098	Crystal Units, Quartz, General Specification For
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-I-45208	Inspection System Requirements

(Information on obtaining copies of Military specifications is given in paragraph 1.2 of FAA-G-2100/1, Supplement I, FAA List of Applicable Documents.)

3. REQUIREMENTS.

3.1 Equipments to be furnished by the contractor.- The equipment furnished by the contractor shall be complete in accordance with all specification requirements and shall consist of the numbers of each type of receiver (1.2) and antenna (3.17) and the number of remote status units (3.15) specified in the contract schedule. Instruction books, in accordance with FAA-D-638, shall be furnished in the quantities defined in the contract schedule. A single instruction book shall cover all equipment classifications described herein which are furnished under the contract.

3.1.1 Crystal units.- The equipment design shall employ crystals units in accordance with MIL-C-3098. Crystal units shall not be furnished with the equipment. However, the contractor shall provide crystals for test purposes (section 4).

3.2 Definitions.

3.2.1 Service conditions.- Service conditions shall be as defined in paragraph 1-3.2.23, FAA-G-2100/1 with 120 V AC (design center) input and Environment I for the receivers and remote status units, and Environment III for the antennas.

3.3 General functional requirements.- The equipments specified herein consist of crystal-controlled superheterodyne receivers with antennas designed to monitor the ILS localizer and glide slope facilities at those locations where metallic monitor lines are not provided. Visual and aural alarms are furnished to operations personnel when a facility goes out of service as evidenced by loss of, or significant reduction in the level of the received RF signal (3.9). An ILS remote status unit is included as required to extend the alarm functions to another location. All active electronic devices shall be semi-conductor devices in accordance with FAA-G-2100/3. Printed wiring is not mandatory but, if utilized, shall be in accordance with FAA-G-2100/4.

3.4 RF input signals.- All performance requirements shall be met when a localizer or glide slope signal having the following characteristics is introduced at the RF input connector of the receiver.

	<u>Type I</u>	<u>Type II</u>
RF Input Signal Level (non-alarm)	5 microvolts to 50 millivolts	5 microvolts to 50 millivolts
RF Frequency	108.1 - 111.9 MHz	329.3 - 335.0 MHz

3.4.1 Input signal modulation characteristics.

All performance requirement shall be met when the input signals are unmodulated carrier signal and also when the input signals are amplitude modulated with 90 Hz or 150 Hz navigational tones to a level of 40 per cent for the Type I receiver and 80 percent for the Type II receiver.

3.5 Frequency channels.

3.5.1 Type I receivers.- Each Type I receiver shall be capable of operating on 20 frequencies (one at a time) within the band of 108.1 to 111.9 MHz, based on a 200 kHz localizer separation. The lowest channel operates on an assigned frequency of 108.1 MHz and the highest on an assigned frequency of 111.9 MHz.

3.5.2 Type II receivers.- Each Type II receiver shall be capable of operating on 20 frequencies (one at a time) within the range of 329.3 to 335.0 MHz, based on a 300 kHz glide slope channel separation. The lowest channel operates on as assigned frequency of 329.3 MHz and the highest on an assigned frequency of 335.0 MHz.

3.6 RF tuning.- The RF circuits of the receiver shall be continuously variable over the specified frequency band. It shall be possible to tune the receiver

to all of the specified channels (one at a time with the proper crystal installed) by tuning for maximum voltage indication at the metering jack(s) (3.11.3). Tuning controls shall be immediately accessible upon opening the receiver unit front door.

3.7 RF frequency characteristics.

3.7.1 Local oscillator.- The local oscillator output frequency shall remain within 0.005% of the design center frequency for operation on the assigned channel over the range of service conditions.

3.7.2 Image and IF rejection.- The image and IF rejection for both types of receivers shall be at least 60 dB.

3.7.3 Receiver IF response characteristics.- The receiver IF response characteristics relative to an input signal at the IF design center frequency shall be as follows. These requirements shall be met over the service conditions.

	<u>Attenuation</u>	<u>Frequency</u>
Type I (ILS Localizer)	less than 3 dB at least 60 dB	+6 kHz <u>+100 kHz</u>
Type II (Glide Slope)	less than 3 dB at least 60 dB	+18 kHz <u>+300 kHz</u>

3.7.4 Oscillator coupled output.- Oscillator, oscillator harmonics and all other spurious outputs shall not exceed 20 microvolts as measured at the antenna receptacle terminated in 50 ohms.

3.8 RF input circuits.- Both Type I and Type II receivers shall have their input circuits designed for use with 50 ohm unbalanced coaxial cable. The input circuit VSWR shall not exceed 1.5 over the frequency band (3.5.1 and 3.5.2). The input connector shall be, type "N" female and shall be located on the rear of the unit chassis. A mating cable connector shall be furnished with each receiver for attachment to type RG-214/U cable.

3.9 Threshold sensitivity control.- A threshold sensitivity control shall be incorporated in the receiver to provide operation over the range of input signals specified in 3.4. After initial adjustment at any input signal level between 10 microvolts and 50 millivolts utilizing only an external voltmeter and the test jack(s) of 3.11.3, the receiver shall not alarm when the input signal level is subsequently reduced by 6 dB, but shall alarm when the input signal level is reduced by 14 dB. The threshold sensitivity control shall be immediately accessible upon opening the receiver front door.

3.9.1 Alarm level differential.- For any alarm level threshold setting, the difference in input signal between alarm actuation (decreasing signal level) and restoration of normal indication (increasing signal level) shall not exceed 1.0 dB.

3.9.2 Alarm level stability.- The stability of the alarm level shall be such that the requirements of 3.9 above are met throughout the equipment service conditions after initial adjustment of the control at normal test conditions.

3.10 RF sensitivity.- The RF sensitivity shall be such that at minimum setting of the threshold sensitivity control (3.9) the receiver shall provide a no-alarm indication with an input signal of 5 microvolts. At no setting of the control, however, shall it be possible to obtain a no-alarm indication when the input signal is removed completely.

3.11 Alarm circuits

3.11.1 Alarm indications.- The alarm circuits shall incorporate a green and red light, green for satisfactory operation and red for an alarm condition. In addition, an aural alarm shall be provided to work simultaneously with the red light. A manual, momentary contact, SILENCE button shall be provided to permit silencing of the aural alarm only, the red light remaining on as long as the alarm condition persists. Restoration of normal input signal to the receiver shall automatically reset all alarm circuits to normal, including the enabling of the aural alarm circuit for operation upon the next subsequent loss of signal.

3.11.1.1 Aural alarm devices.- Aural alarm devices shall be of the type which produce most of their sound output energy within the range of 250 to 2500 Hz, either continuously or in short equal bursts (2 to 6 per second). Maximum output shall correspond to a sound pressure level between 60 and 70 dB (reference pressure of 0.0002 dynes per square centimeter). Each alarm device shall be provided with a loudness control for continuous reduction of the sound level to a minimum level of 30 to 40 dB. Alarm devices and their associated loudness controls shall be mounted on the front panels of the equipment units. Alarm devices shall be rated for continuous un-interrupted service at maximum output level.

3.11.2 Time Delay.- An adjustable electronic time delay of 0 to 60 seconds shall be incorporated in the alarm circuit to prevent an alarm indication until the expiration of the preset interval. Restoration of normal signal shall automatically reset the time delay.

3.11.3 Metering jacks.- Pin type metering jacks shall be provided on the receiver unit chassis for all tuning and level adjustments (3.6 and 3.9). The metering jacks shall be accessible immediately upon opening the unit front door. All tuning and level adjustments shall be capable of accomplishment utilizing only an external D.C. test multi-meter (not required to be furnished under this specification) of 20,000 ohm per volt sensitivity.

3.12 Remote alarm capability.- The status light, aural alarm, and silence switch circuits shall be brought out to a terminal strip on the rear of the receiver unit chassis for remoting these indications and controls to the ILS remote status unit. The terminal strip shall be of the barrier type, Howard B. Jones, 142-Y, Kullka 602-Y, or equal. (Paragraph 1-3.15.3 of FAA-G-2100/1 shall not apply to the insulating material of the terminal strip). The receiver unit shall be capable of operating the remote alarm indicators

as well as its own alarm indicators when the receiver and remote units are interconnected by up to 200 feet of AWG No. 22 multiconductor cable. (Interconnecting cable is not required to be furnished under this specification).

3.13 Fail Safe.- The equipment specified herein shall be fail-safe in design i.e. failure of any part thereof shall either result directly in an alarm condition or, as a minimum, shall not cause the receiver to tolerate a greater reduction in input signal for alarm than that required in the absence of part failure. Open circuits in the signal path(s) of the receiver shall at all times produce an alarm indication (see also 3.10). For such parts as electronic or electro-magnetic switching devices where it is not practical to provide protection against both modes of failure (open circuit and short circuit), fail safe operation shall be provided for the mode of failure having the higher probability of occurrence in the circuit application. (Failure of the alarm indicator devices themselves are exempt from these requirements as are failures of the power sources for these devices providing, in the latter case, that failure of any power source results simultaneously in de-energizing the non-alarm indicators as well.)

3.14 Receiver construction.- Each receiver unit shall be constructed on a Type I Size C Rack Panel-Door and Vertical Chassis, as specified in FAA-G-2300. Provided on the front panel shall be an AC power toggle switch, fuse, power indicator light and nameplate (all as defined in FAA-G-2100/1) and the alarm lights, aural alarm device, loudness control, and silence button (3.11.1 and 3.11.1.1). Indicator lamp supply voltage shall not exceed 28 volts (design center). Lamp and light assembly types shall be selected accordingly from 1-3.16.5.1 of FAA-G-2100/1. The AC power receptacle (FAA-G-2300), terminal strip (3.12), and RF input connector (3.8) shall be provided on the rear of the chassis.

3.15 Remote status unit construction.- The remote status unit shall be of completely enclosed metal structure not to exceed 6" x 6" x 6" designed either for desk top use or for mounting within a rectangular cut-out in an operating console. For this purpose, the bottom surface shall be provided with four (4) rubber feet and the front surface shall provide a flange with eight (8) holes for console mounting. Except for the rubber feet, there shall be no protrusions on the bottom, top, or sides of the unit to interfere with installation or removal of the unit from the console. A single removable top cover shall provide ready access to all parts within the unit. Provided on the front panel shall be two sets of red and green alarm status lights, an aural alarm device, loudness control, and silence switch, all of the same types used on the receiver units. Each set of indicator lights shall parallel the lights of one of the two receivers. One set of lights shall be labeled LOCALIZER and the other GLIDE SLOPE. Operation of the silence button shall silence all aural alarms, however, the loudness control shall affect only the output of the aural alarm device on the remote control status unit. Facilities for interconnection shall be provided by the use of two (2) recessed male connectors on the rear of the unit. The connectors shall be Howard B. Jones, No. P-306-DB, or equal. Two (2) mating connectors, Howard B. Jones No. S-306-CCT, or equal, shall also be furnished. (Paragraph 1-3.15.3 of FAA-G-2100/1 shall not apply to the insulating material of these connectors.)

3.16 Power source.- The receivers shall operate from a single-phase, 120 volt, 60 Hz (design-center values) two wire AC power source.

3.17 Antennas.- Antennas, Type I and Type II, shall be designed for operation in conjunction with Type I and Type II receivers respectively (1.2).

3.17.1 Electrical characteristics.- Each antenna shall be a horizontally polarized half-wave dipole with a design center impedance of 50 ohms. The VSWR as measured at the output connector over the specified frequency range (3.4) shall not exceed 1.25 under normal test conditions nor 1.5 under condition of simulated rainfall equivalent to 4 inches/hour. The input connector shall be type "N" female. A mating cable connector shall be furnished with each antenna for attachment to type RG-214/U cable. Antenna cable shall not be furnished under this specification.

3.17.2 Mechanical detail.- Each antenna shall be constructed of aluminum alloy with means for mounting atop a 1-1/2 inch iron pipe or bolting to the side of a wooden pole.

3.18 Nameplates.- Nameplates in accordance with 1-3.13.1, FAA-G-2100/1 shall be provided for each unit of equipment. The titles shall be as follows:

ILS LOCALIZER REMOTE MONITOR RECEIVER
ILS GLIDE SLOPE REMOTE MONITOR RECEIVER
ILS REMOTE STATUS UNIT
ILS LOCALIZER REMOTE MONITOR ANTENNA
ILS GLIDE SLOPE REMOTE MONITOR ANTENNA

4. QUALITY ASSURANCE PROVISIONS.

4.1 Inspection system.- The contractor shall be responsible for the inspection and testing of equipment and materials for conformance to specification requirements and shall utilize, for this purpose, an inspection and test system in accordance with Specification MIL-I-45208. See Section 1-4 of Specification FAA-G-2100/1 for additional specific requirements.

4.2 Design qualifications tests.- In addition to those tests specified in paragraph 1-4.3.2 of FAA-G-2100/1 the following tests shall be conducted. Except where stated otherwise, these tests shall be conducted under normal test conditions.

<u>Test</u>	<u>Paragraph</u>
Input signal modulation characteristics (110.1 and 332.0 MHz)	3.4.1
RF tuning (108.1, 110.1, and 111.9 MHz)	3.6

<u>Test</u>	<u>Paragraph</u>
RF tuning (329.3, 332.0 and 335.0 MHz)	3.6
Localizer Oscillator output frequency (102, 120, and 138 VAC)	3.7.1
Image and IF rejection	3.7.2
Receiver IF response (at +10°C and +40°C)	3.7.3
Oscillator coupled output	3.7.4
Receiver input VSWR	3.8
Threshold sensitivity control (at 102 and 138 VAC after initial adjustment at 120 VAC)	3.9
Alarm level differential (102, 120, and 138 VAC)	3.9.1
RF sensitivity (102, 120 and 138 VAC)	3.10
Aural alarm output levels and frequency characteristics (102, 120, and 138 VAC)	3.11.1.1
Tuning and adjustment capability	3.11.3
Remote alarm capability	3.12
Fail Safe	3.13
Antenna VSWR under simulated rain	3.17.1
Antenna wind and ice loading (by calculation and application of static load)	1-3.3.2 of FAA-G-2100/1

4.3 Type tests under normal test conditions.-The following tests shall be conducted.

<u>Test</u>	<u>Paragraph</u>
Receiver IF Response	3.7.3
Antenna VSWR (108.1, 110.1 and 111.9 Hz)	3.17.1
Antenna VSWR (329.3, 332.0 and 3350 MHz)	3.17.1

4.4 Type tests under the service conditions.- The following tests shall be conducted in accordance with 1.4.3.3.2 of FAA-G-2100/1 after initial tuning and adjustment of the receiver unit for operation at 110.1 or 332.0 MHz (as applicable) and a normal RF input level of 10 microvolts.

<u>Test</u>	<u>Paragraph</u>
Local Oscillator	3.7.1
Threshold Sensitivity Control	3.9
Alarm Level Differential	3.9.1
Alarm Indications	3.11.1 and 3.15

4.5 Production tests.- The following test shall be conducted on each unit under normal test conditions.

<u>Test</u>	<u>Paragraph</u>
Threshold Sensitivity Control (at 10, 100, and 1000 microvolts and at 50 millivolts.)	3.9
Alarm Level Differential (as above)	3.9.1
RF sensitivity	3.10
Operation of alarm in- dications and controls	3.11.1, 3.12 and 3.15
Antenna VSWR (110.1 MHz)	3.17.1
Antenna VSWR (332.0 MHz)	3.17.1

5. PREPARATION FOR DELIVERY.

5.1 General.- Unless otherwise specified in the contract, the equipment shall be prepared for domestic shipment in accordance with the following sub-paragraphs.

5.2 Preservation and packaging.- Preservation and packaging shall be in accordance with Specification MIL-E-17555, Level A.

5.3 Packing.- Packing shall be in accordance with Specification MIL-E-17555, Level B.

5.4 Marking.- Each package and shipping container shall be durably and legibly marked with the following information:

Name of Item and FA Type Number
Serial Number(s)
Quantity
Contract Number
Federal Stock Number
Gross Weight of Container
Manufacturer's Name

6. NOTES

6.1 Typical design.- Figures 1 and 2 are functional block diagrams of a typical alarm circuit. These figures are furnished for informational purposes only. The Government does not represent or guarantee that conformance thereto will insure that the resulting product will meet specification requirements. Any reliance which the contractor places on figures 1 and 2 is wholly at his own risk and shall not relieve him of his contractual obligation to comply with all the requirements of this specification.

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FOR FIGURES 1 and 2, SEE PAGES 11 AND 12.

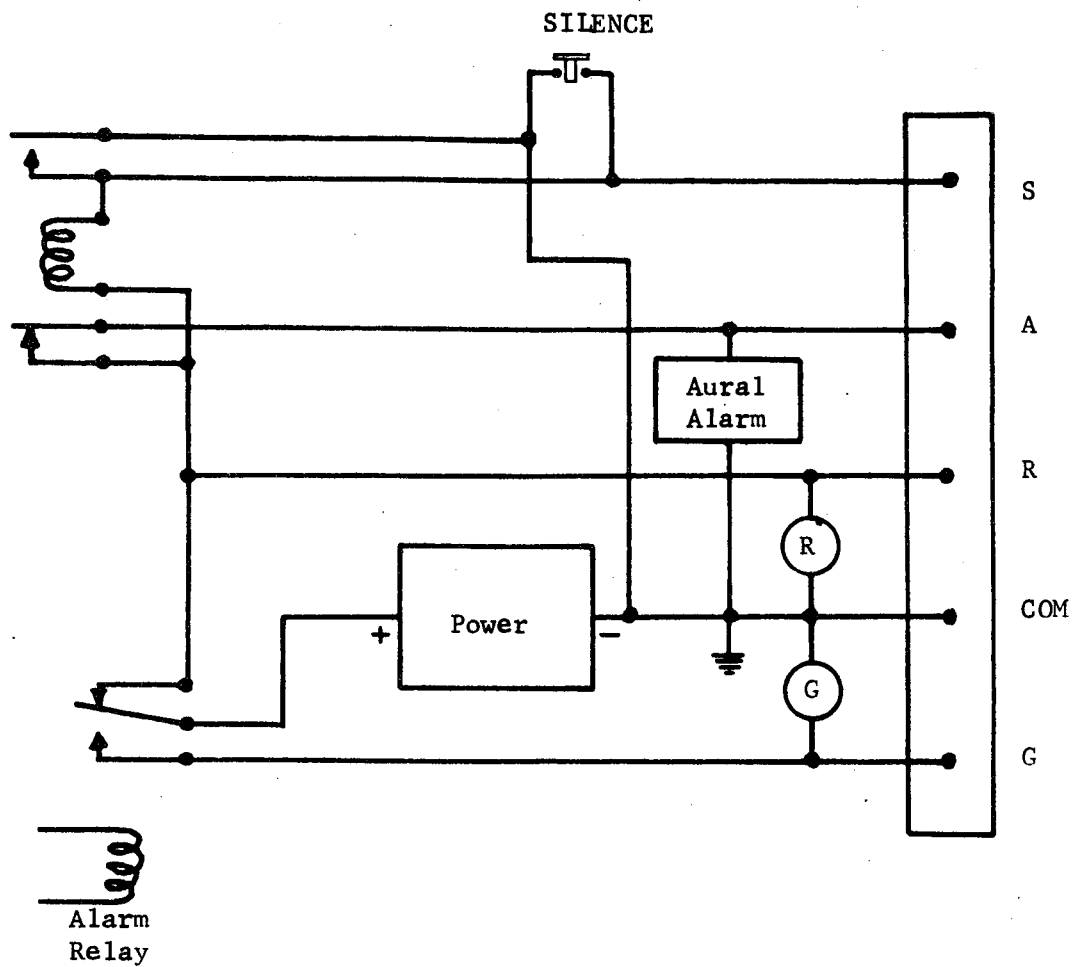


FIGURE 1

ILS REMOTE MONITOR RECEIVER

ALARM CIRCUIT

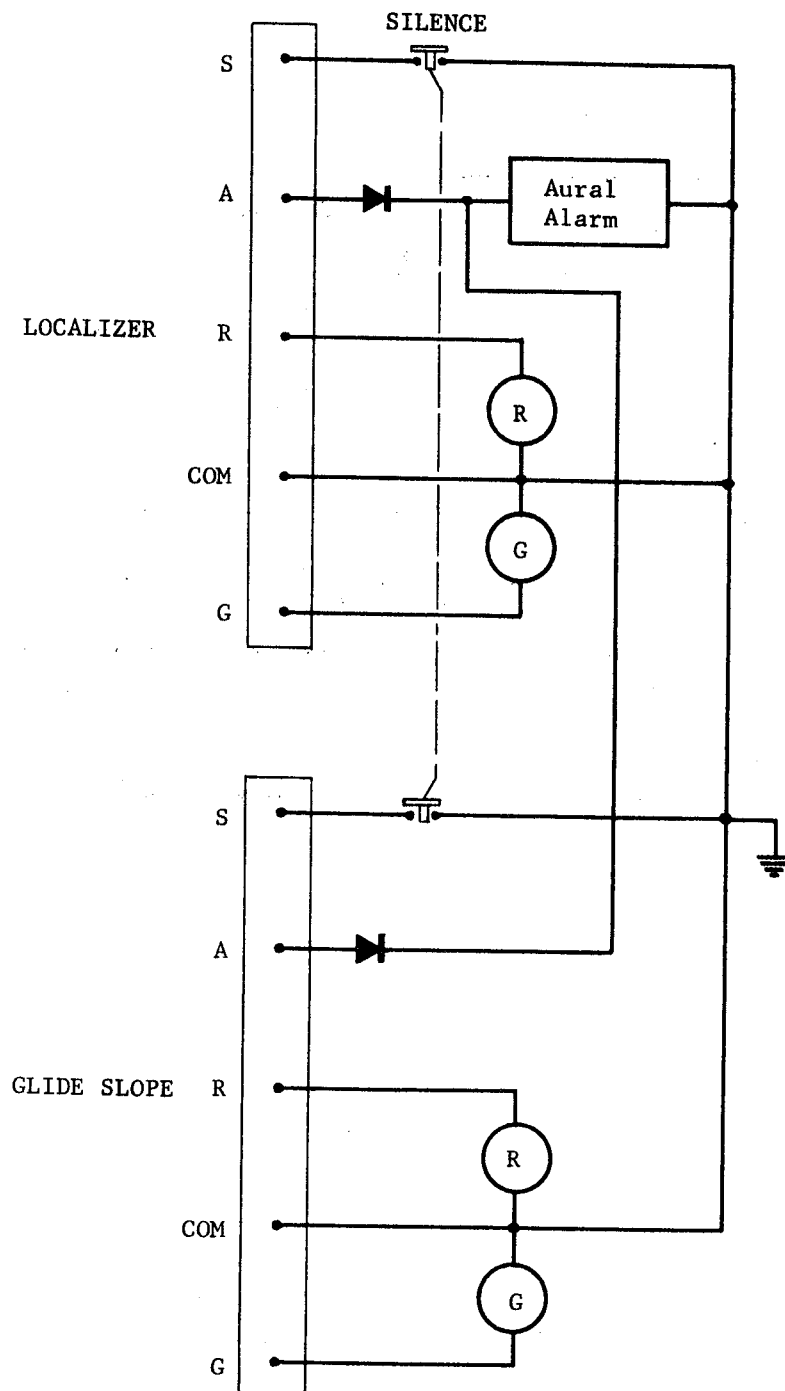


FIGURE 2

FUNCTIONAL DIAGRAM

ILS REMOTE STATUS UNIT